M/R289

FAO Fisheries Report No. 289 FIPP/FIRM/R289

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Report of the

EXPERT CONSULTATION ON THE REGULATION OF FISHING EFFORT (FISHING MORTALITY)

Rome, 17-26 January 1983

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

REPORT OF THE EXPERT CONSULTATION ON THE REGULATION OF FISHING EFFORT (FISHING MORTALITY)

Rome, 17-26 January 1983

A Preparatory Meeting for the FAO World Conference on Fisheries Management and Development

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome 1983

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M-43
ISBN 92-5-101394-2

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PREPARATION OF THIS DOCUMENT

This is the report of the Expert Consultation on the Regulation of Fishing Effort (Fishing Mortality), one of the preparatory meetings for the World Conference on Fisheries Development and Management, as approved by the participants at the conclusion of the meeting in Rome, 17-26 January 1983. A more extensive study of the problems of controlling fishing effort, based on the written contribution to the Consultation, and the discussions during the meeting, is being prepared by Drs. Beddington and Rettig, and will be issued as a Fisheries Technical Paper. A selection of the papers submitted to the Consultation will be issued as a supplement to this Report.

ABSTRACT

The problems of controlling fishing effort are reviewed. Any method should satisfy certain criteria - maintaining the productivity of the resource, economic performance, and equity (or social needs). The methods of achieving these objectives are reviewed; they include catch limits, direct control of fleet capacity (e.g., licence limitation), indirect measures (mesh size, closed areas), financial measures, and property rights. The advantages and disadvantages of each approach are discussed in the light of the established criteria. There is no simple single method. Management of most fisheries will require a mix of several approaches and cannot be separated from development.

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For bibliographic purposes this document should be cited as follows:

FAO, 1983 Report of the Expert Consultation on the regulation of fishing effort (fishing mortality). Rome, 17-26 January 1983. A preparatory meeting for the FAO World Conference on fisheries management and development. FAO Fish.Rep., (289):34 p.

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OPENING OF THE MEETING

1. The Expert Consultation on the Regulation of Fishing Effort was held in Rome, from 17 to 26 January 1983. It was attended by 18 experts as well as by six FAO Consultants and seven FAO staff members. A List of Participants is given in Appendix 1.

2. The Consultation was chaired by Dr. G.D. Waugh. A welcoming address was given by Dr. D. Menasveta on behalf of the Officer-in-Charge of the Fisheries Department, Dr. A. Labon.

3. The Consultation approved the Agenda and Timetable as given in Appendix 2. The List of Documents presented during the meeting is given in Appendix 3.

CRITERIA FOR REGULATION (Papers 1, 2, 3 & 4)

4. One of the reasons for calling for a thorough re-examination of the Law of the Sea (LOS) a decade or more ago was the concern with the depletion of many fish stocks, and with the difficulties in dealing with this under the current international regime. The new Convention provides countries with the opportunities, and also the responsibilities, to manage fisheries, especially in the national extended economic zones (EEZs). Without management, resources can be threatened, the amount and stability of fish supplies reduced, and countries can fail to achieve the considerable economic and social benefits that can come from healthy fishery industries and fishing communities. At the same time all management, in the sense of one form or another of government intervention, has some costs, which tend to increase with the amount and complexity of the intervention. There must, therefore, be a favourable balance between the costs and benefits of any proposed management. This balance will vary with the state of development of the country and of the specific fishery. There may even be some cases where conditions, e.g., small size of the fishery, and difficulties of intervention, may mean that a management decision by the Government not to attempt to regulate fishing effort would be justifiable.

5. Participants in the Consultation had been chosen on the basis of their experience in successful and unsuccessful regulation of effort. These experiences had inevitably been predominantly in the developed countries in the North Atlantic and the North Pacific where over-capacity has been a crucial problem for the last twenty years or so. It was recognized that having identified the factors of success and failure in developed countries further studies and consultations were necessary to evaluate the possibility of transfer of these experiences into the terms of specific advice to individual developing countries. There was however a considerable range of conditions within countries, and it was believed that these subsequent discussions would be best handled at the regional (e.g. south-east Asia, Latin America) level as already planned, for instance, in the Committee for the Development of Fisheries in the Central-Eastern Atlantic (CECAF) in 1983.

6. The Consultation reviewed the general objectives of fishery management and the criteria that might be used in evaluating different systems. It was emphasized that there must be an understanding of the objectives before starting to manage but that this need not require explicit and detailed specification of the objectives. Indeed there might be advantages initially in leaving the statement of objectives in general terms. There are a variety of objectives that might be considered. These cannot always be achieved simultaneously and it may be desirable for the decisions between objectives to be taken over time as part of the regular management process.

7. It was agreed that objectives could be placed in three groups - maintaining the resources, economic performance, and equity (or social needs). These could be used as criteria in judging the performance of different management schemes, but in addition the transaction costs (the costs of research, administration and enforcement) should also be taken into account. That is, the cost of achieving the mix of objectives (cost/benefit) is an integral part of the iterative process of setting and refining objectives. It is recognized that quantification of benefits is sometimes difficult. But it is essential to the decisions on amount, methods and complexity of regulation.

8. The Consultation recognized that attaining maximum rent normally does not seem to be the main objective for the fishery management. Even when accepting this, it should however be stressed that objectives concerning economic efficiency should not be omitted. If they are ignored, the long-term effect would be that the fishery sector develops to be a burden for the society rather than the source of secure work places and food supply. The criteria used to determine economic efficiency will obviously vary from country to country owing to employment needs, scarcity of fuel and other special conditions.

9. All management measures affect fishermen. Therefore the interests and views of the fishermen must be taken into account. The over-whelming majority of fishermen are small-scale fishermen, who account for a high proportion of the world's total fish production. Most of these fishermen live in communities with long traditions of fishing. These communities have evolved complex patterns of competition and cooperation, which must be taken into account in any management scheme. If fishermen are convinced that regulations are necessary and fair they are more likely to comply with them. On the other hand, fishermen will not obey laws they do not respect, and attempts to enforce such laws will face immense difficulties.

10. It was suggested that small-scale artisanal fisheries pose much less threat to the resources than modern industrial fisheries. This is certainly true of traditional fisheries, which may have reached a balance between man and the resource over a long period. However, with the growth of population, better marketing and the spread of new technology (outboard motors, synthetic nets), many artisanal fisheries are putting greater demands on the resources. It might be unfair to blame artisanal fisheries for depletion of resources, but it would be equally wrong to believe that these fisheries were free of the management problems besetting many of the industrial fisheries of the world.

11. The processing and marketing sector plays a vital role in all fisheries, but one that has been often neglected in considering fishery management. This usually focusses on the catching side. As a result the needs of the processors - for an even and predictable supply of fish, with emphasis on quality, and catching at times and places when quality is best - have been neglected. As a result the regulations can result in the total value of the catch - either at first sale or to the ultimate consumers - being much less than it might have been.

TECHNIQUES OF REGULATING FISHING EFFORT

Regulation by Catch Limits

12. Discussion of this topic was started by the presentation of the working papers (1.1 to 1.13). These gave a general over-view of the topic (paper 1.1), a description of some of the processes and problems involved in the scientific work of determining catch limits (papers 1.2 and 1.4) and the practical experience in a

number of United States fisheries (papers 1.5, 1.9, 1.11, 1.12 and 1.13), in Canada (paper 1.7), in Chile (paper 1.6), and in the European Economic Community (EEC) (papers 1.3 and 1.10). To the extent that a common theme ran through all these papers it was that the implementation of catch limits was likely to run into severe difficulties. However, the same or similar difficulties were likely to be met by any other method of control. Properly applied catch limits are capable of being a useful, if not the most useful, way of managing fisheries.

13. Before starting to apply catch limits, or indeed any form of management, there must be a clear understanding of the objectives. This need not be a detailed and explicit statement, which could be harmful in the future if conditions change and which could arouse expectations that could not be met.

(i) Setting the Total Allowable Catch (TAC)

14. Given the objectives, the first stage in control by catch limits is to determine the amount of the total catch that should be taken. Such objectives could be rather specific (for example, the achievement of a target stock size or fishing mortality) or more general (e.g., to avoid over-fishing, or to increase stock size). Whatever the objectives this is essentially a scientific task, but there was some discussion on who should take the final decision on the actual value. Some participants felt that the scientists should confine themselves to spelling out options and the biological effects of the different options. Others felt that scientists should, in the light of their understanding of the resource, and of the objectives of management, set a definite total allowable catch (TAC) or safe biological limit. This difference might reflect the varying experiences of participants, especially whether (as in multi-national fisheries) management decisions were taken by consensus or committees, or (as in purely national fisheries) by a single identifiable authority. The state of development of the industry was also relevant.

15. The Consultation recognized that the changes in fishery jurisdiction around the world has changed drastically the conditions under which the catch limits (or other controls) were set. In considering the concept of "surplus" in the text of the Law of the Sea treaty, it was decided for the purpose of the Consultation to consider that the coastal state had full discretion in setting the allowable catch, and its own harvesting capacity. However, it was recognized that alternative interpretations had been suggested.

16. Emphasis was placed on the large amount of work involved in calculating TACs, at least in the detail and with the frequency required in the North-East Atlantic. Concern was expressed at the costs involved, and on the impact of the workload on the general scientific activity. This implied that scientists were generally involved in considering only short-term problems, to the exclusion of those posed in the medium and long term. It was felt that this was likely to affect the overall quality of the scientific advice.

17. Calculations need not always be done annually. The frequency of re-assessment could be less for long-lived stocks, for stocks with relatively low exploitation rates, and for those in which the recruitment did not vary much.

18. The Consultation considered the precision and reliability that might be expected, and was actually being achieved, in calculating TACs. It noted that the more reliable figures of TACs had been those produced by working groups in which the scientists involved had been closely familiar with the fishery, or where recruitment varied little. It was suggested that the precision of current TACs

could be increased by more careful design of the data collection and analysis - as well as by a general expansion of research work - but that there was an irreducible minimum - perhaps 10% - below which the variance could not be reduced. Of the factors involved, the most important was the estimate of the strength of the recruiting year-class.

19. It was pointed out that the precision required, as well as the frequency of re-assessment, depended on the management strategy. If it was aimed at squeezing as much as possible out of the resource, the penalties for error could be severe, and high precision was needed. This further implies that high quality data must be collected at correspondingly high cost. On the other hand, if the manager was content with a rather smaller catch, leaving à reasonable safety margin, larger errors could be accepted. There were also other similar trade-offs, e.g., between the average catch level and the year-to-year variation around that average. Processors might well prefer a lower average with lower variation.

(ii) Allocation of shares on a TAC

20. Once a limit on the total catch has been set, this total is usually allocated in some way. In an international fishery the first stage is to make national allocations; these allocations (and the total catch in a single-nation fishery) may then be divided among different groups within the country. This process causes problems which are often severe. Nevertheless, it was agreed that these were necessary evils. If there were no allocation, and a ceiling on the total catch was the only control, then there would be no check on the growth of capacity. This creates a number of difficulties including the likelihood of severe disruption in the seasonal pattern of fishing. This was likely to cause severe economic inefficiencies, with the risk of the type of economic disaster as had occurred in the Alaska king crab fishery. It was also pointed out that even if no explicit decision on allocation were taken, this decision itself resulted in an implicit allocation of benefits, e.g., to those who were in the best position to catch more fish early in the season.

21. So far as national allocation in a multi-national fisheries were concerned, four situations were distinguished: fishing with open access; transboundary (shared) stocks; anadromous stocks; and foreign fishing in a national EEZ. Under the pre-LOS conditions, the open access fishing was the typical situation. Now, high sea stocks such as tunas are the only examples.

22. The European Economic Community (EEC) is a unique example of a group of nations which have agreed to combine their fishery resources and act as a single coastal State, both allocating their common resources amongst themselves on an agreed basis and negotiating as a unit with States which are not members of the EEC concerning allocations to these non-member States.

23. The Consultation believed that to attempt to establish scientific criteria for the allocation of stocks among nations was inappropriate, since such decisions will depend on many additional factors. However, for shared stocks, greater emphasis is likely to be placed on biological characteristics of the stocks, e.g., location of spawning groups. These could provide an objective initial basis for negotiations. For this it would be useful for the biological advice to come from a wide group - even including those not directly concerned with the negotiations - thus reducing the chances of bias. This was felt to be true even by those who believed that the actual negotiations should be restricted to those immediately concerned.

24. For stocks found wholly within a single country's EEZ, decisions on the share, if any, taken by foreign vessels were made solely by the coastal State. For anadromous stocks, this decision is made by the nation where the fish spawn. In terms of allocation, less attention is now being paid to historic performance, and more to other factors - compliance with regulations in previous years, cooperation in research or enforcement, access to markets, etc. Where historic performance was still relevant, it was noted that an accurate record on the relevant information did not always exist.

25. The Consultation noted that it was usually implied that the ultimate objective of the coastal State was to phase out all foreign fishing. This need not be the best policy. For example, several stocks vary greatly from year to year, or over a longer period, in abundance or in availability. A sensible policy in this case might be to develop the local fishing capacity only to the level which could operate successfully in the poor years. Any excess over domestic requirements in good years could be offered to foreign fleets, who would have to deal with the problems of over-capacity in poor years.

26. Allocations within a country can improve economic efficiency and equity to an extent which depends on the pattern of allocation. Allocations to individual enterprises can enable them to spread their catches through the season so as to achieve the best prices, or take their catch at least cost. Allocations would normally be in terms of a fixed proportion of the TAC, but variations in the distribution or availability of the fish may make it difficult to achieve this fixed percentage in each and every season.

27. It was stressed that, without allocation, the indirect effects of quota controls (e.g., a short open season) could change the relative efficiencies of different types of vessels. Large, expensive and technologically advanced vessels were seldom the most efficient. However, smaller vessels usually need to be able to operate over an extended period; the large vessels tend to be used, and appear more efficient, when the open season is drastically reduced.

(iii) Administration of catch limits

28. Administration and enforcement of any regulation must involve the fishermen. Without the understanding and reasonable collaboration of the fishermen, enforcement is difficult if not impossible. It was pointed out that when fishermen were convinced that a regulation was necessary and fair, they were the best policemen for the enforcement of the regulation. On the other hand, there were some regulations which have had the effect of forcing honest men to become law-breakers to maintain their livelihood. It was felt that every effort should be taken to avoid this situation.

29. The Consultation noted that there were some differences among countries in the degree to which fish buyers and fish processors are involved in enforcement. It was pointed out that in respect of, for example, fish caught in excess of a catch quota, the position of a fish buyer could be considered as analogous to the receiver of stolen goods. Enforcement of catch quotas was likely to be easier if both the fisherman and the buyer of his fish could be prosecuted for breaking the regulation.

30. There was considerable discussion of the impact of catch limits on the quality of statistical data, particularly the figures of total catch used in stock assessment. It was recognized that there were a number of fisheries in which

the figures officially reported are almost certainly substantially smaller than the real values. Some participants suggested that it might be useful to set up parallel systems of data collection (for enforcement and research). Others felt strongly that this was undesirable, particularly in the long term. Such systems, and also the custom of "confidentiality" of statistical returns, could be interpreted as an official acceptance of mis-reporting.

31. Log-books are an important source of data. Two uses were mentioned: a compulsory system for enforcement, and a system to provide statistical data in more detailed form than was generally available from past records. These uses should not be confused, nor should there be any attempt to operate two sets of systems - fishermen have enough to do already. Where the catch controls are complex, including distinct figures for different areas and stocks, some form of compulsory log-book is likely to be an essential adjunct to other forms of control.

32. In the last instance, control and enforcement involves a court of law. The more complicated the regulation - a quota of 13 cwt per crew member per week was mentioned as an example - the more chance there was that legal proceedings would meet problems in such matters as definitions - when is a boat actually fishing, what is the actual size of crew, etc. It was emphasized that the judicial procedure and in particular the sentencing policy could play a key role. The confidence of fishermen in the effectiveness of regulations and their willingness to assist in proceedings against offenders is undermined if the penalty is mild, and the offender is back fishing the next day. It was noted that in Alaska the objective in setting penalties on serious offenders was to ensure that they ceased to go fishing.

33. Enforcement is expensive - as indicated by the costs of the vessels and aircraft used by the United States (document 1.8). Many participants felt the current costs were too high by any reasonable standard, though were often unavoidable. Attention was given to possible methods of reducing costs. The use of fishing boats for surveillance duties was suggested. The possibilities of using special hardware (e.g., data loggers, similar to aircraft "black boxes") were raised. The type of hardware most often considered was some form of transponder which identified the vessel and its position, and was linked to a satellite. Moreover, with present technology these were not cost-effective. On the other hand, simple aircraft could maintain surveillance over large areas at a reasonable cost.

Alternative approaches to effort regulation and some special problems

34. The general over-view paper (2.1) as well as the papers reviewing experience with Pacific halibut (2.5), in Cuba (2.7), and in Israel (2.8) noted that alternative approaches have been used from earliest times and in most regions. They are still the main controlling measures in traditional fisheries, especially in inshore fisheries. Some of these measures are embodied in regulations; others result from various cultural practices specific to particular areas.

35. The Consultation noted that the objectives of introducing these measures had been varied. The main impacts and subsequent rationalization of these measures often differed from the reason initially put forward for management. This feature has led to a great deal of confusion on the true impact and potential of these types of measures. The following classes of objectives were considered:

(a) **Economic :** e.g., a fishery may be closed at the time of poor market conditions, or when the fish are in poor condition, or at times or for areas and seasons when poisonous fish or shellfish are likely to be caught.

(b) **Equity :** e.g., the closure of belts close to the coast to fishing by trawlers is a common feature in many areas, particularly in the tropics, to protect the small-scale fishermen, and to minimize conflicts (e.g., in Malaysia).

(c) **Social :** e.g., to avoid fishing at times of the year when weather or other conditions mean that fishing is dangerous or when other activities are more important.

(d) **Biological :** e.g., closure of nursery grounds and closed seasons can be measures to protect juveniles; they may also be used to protect by-catch species (e.g., the North Sea Norway pout box). Closed seasons can be used to protect spawning fish.

36. Closed seasons have also been applied to fisheries, such as lobster and lane snapper in Cuba, and blue fin tuna for which the vulnerability is so high at certain times that direct controls alone (e.g., limiting the number of vessels) might not be effective in keeping the exploitation rate to an acceptable level. In multi-species fisheries closed areas and seasons can help adjust the balance of fishery pressure between different species.

37. Closed seasons can be quite effective in protecting highly vulnerable stocks; when used as the main measure for controlling effort, such closures can result in impractically short seasons. This may lead to a loss in economic productivity as capacity rates expand and fishermen operate far below their maximum efficiency. However, an advantage of seasonal closures is that they can be relatively easy to enforce.

38. These indirect methods have advantages; they can be relatively cheap and easy to administer; they can be quite acceptable to fishermen; and they can be a simple way to administer TACs. As used in Cuba and Iceland, closed areas/seasons have proved useful tools as part of a responsive, hands-on system of management.

39. In further discussion it was noted that the implementation of closed areas or seasons could involve significant legal and administrative problems. Inshore fishermen do not always carry charts and therefore may not know where closed areas are. Definitions of areas are not always obvious, e.g., 3-mile limits from base lines. Definitions of areas are sometimes arbitrary (by latitude and longitude) and may not seem sensible to fishermen. The use of coordinates expressed in terms of navigational aids (e.g., Loran, Decca) where these are used by fishermen would be more acceptable and less ambiguous. Where fishing is allowed for some species in an area, but not for others, then infringements may be difficult to spot. With closures a precise legal definition of fishing will be needed. The legal definition of fishing proposed in one country was that it is initiated with the setting of the gear, and finished when the last fish is removed from the water.

40. Enforcement of closed areas and seasons involves the same question of costs and effectiveness as were noted in relation to catch quotas though the costs are generally less. The possible use of transponders, which could establish the actual pattern of fishing activity was again mentioned. Aerial surveillance can often be very cost effective in controlling closed areas.

41. Closed areas or seasons designed to prevent fishing on some species may prevent legitimate catches of other species. Closed seasons may affect single stock fishermen more than those who can divert their effort to other areas and resources. Closed areas created by local authorities/States may be contradictory in impact and may confuse and confound national management aims.

42. In conclusion, the Consultation felt that area and season closures can be very useful for fine tuning of fisheries in combination with other measures, but less efficient alone as prime methods of management. When enforcement is feasible and cost effective, parts of the stock (e.g., juveniles) needing special attention, or all of the stock during periods or in areas of high vulnerability can be protected. However, closed seasons and areas do need to be determined carefully, with particular attention being paid to their impact on other species - especially if effort is diverted elsewhere. In general, these methods should be combined with other more direct approaches to management, especially if fishing pressure is high. It was noted that the long-term consequences of such schemes on the distribution of benefits between fishermen should be carefully examined, because there could be effects which were not intended. Cultural differences in mobility, etc. may result in their having different effects in different countries.

43. Clearly these regulations are most effective when used in conjunction with effort control or quotas as in the Pacific halibut fishery. Some special methods such as seasons of variable duration that can be closed when catch rates fall below a given level may provide a useful tool for some fisheries. A problem common to all of these indirect measures is that they require the cooperation of fishermen to ensure their effectiveness.

44. Closed areas, reserves, refuges and similar measures can help protect against over-fishing of coastal fishery resources and can contribute to other societal goals in the coastal zone. An alternative measure to deal with mis-use of coastal resources has been the allocation of property rights, either to the fish or to access to fishing grounds.

Gear selectivity/mesh regulations

45. Papers were presented describing the general principles of mesh regulation, especially in trawl fisheries (Document 2.4) and the ways in which different types of fishing, and different methods of operating similar gears, can result in catches of very different species and sizes of fish (Document 2.3). The specific experiences with varied use of fixed gear in the halibut and other fisheries were also reported (Document 2.6). The principle of mesh regulation is simple. A mesh size is chosen to release the small, juvenile, fast-growing fish, while retaining those large enough to be a marketable size. This was felt to work well in single-species fisheries, e.g., for cod around Iceland. There were big problems in the multi-species fisheries in the tropics. The optimum mesh size for large species is considerably greater than that for shrimp or the small finfish. Even in these fisheries there could be some benefit from increasing mesh size from the very small size currently used in many fisheries, though the mesh size likely to be adopted would still be very small in relation to the optimum for the larger species; thus other measures are needed. It was suggested that in these tropical fisheries control on the material of the nets (e.g., use of monofilament) might also be useful in adjusting their selectivity. This could be relatively easy to enforce where most material was imported.

46. The Consultation also noted that control of mesh size in trawls was not the only example of management by gear selectivity. Meshes of gillnets, sizes of hooks, and escape gaps in lobster pots were other examples.

47. The subsequent discussions stressed the need to work closely with industry in the development and implementation of gear regulations. A number of ways in which fishermen can avoid or frustrate such restrictions were cited. Fishermen are more likely to conform with regulations if they understand and support the purpose behind them. It was also pointed out that the benefits of changes in gear regulations, e.g., the use of a larger mesh, are likely to be preceded by a short-term loss in landings for a period while the fish released grow. Fishermen, who see the small fish escape, can be expected to oppose the regulation unless further justification is given. The Consultation noted that it is difficult to demonstrate unequivocally the benefits from mesh regulations, even when they are successful. The reason is that the natural variability in fish stocks will mask any increases in the average yield.

48. Much of the discussion focussed on issues related to mesh size restrictions. A number of the practical difficulties with compliance and enforcement which had been made in a number of fisheries were reiterated. The biological bases for mesh restrictions and their effectiveness in preserving stocks or achieving optimal yields, particularly in multi-species and tropical fisheries, were questioned. In addition, their physical effectiveness was queried in relation to the damage that might occur to fish passing through the meshes. Nevertheless, size limits and mesh size regulations may provide a base level of protection to the stock in many fisheries, particularly if, without such control, the fish would be caught before they become mature and spawned. In this particular case, minimum size limits, if they can be enforced, should at least prevent the stock from becoming excessively depleted even if other measures controlling fishing mortality are temporarily ineffective. They are particularly useful for those species (e.g., lobsters, scallops) where under-sized specimen can be returned to the sea alive.

49. A number of speakers referred to refinements or additions to management systems which may assist regimes based on gear restrictions. Monitoring of key species in a fishery, and selective quotas or closures, were considered to be important adjuncts to gear restrictions in many circumstances.

50. Changes in gear regulations should, where possible, allow time for the fishermen to replace old gear in normal rotation rather than force them to scrap useful equipment.

51. A number of speakers noted that the most successful fishermen frequently voluntarily use larger mesh sizes than the regulations require, presumably because of a better market price for larger fish in many areas. Also, fishermen are more likely to evade gear restrictions when fisheries are over-fished and economically depressed.

52. It was noted that mesh size regulations had often been introduced when the fishing intensity had already substantially reduced the average size of the fish present. The mesh size regulation then often merely reflected the de facto situation. In such situations the mesh size regulation would be ineffective unless coupled with some control over fishing intensity.

53. New fishing technology is allowing fish to be located more quickly and accurately and nets to be shot more frequently. Thus gear regulations will need to be continually monitored to determine their continued effectiveness. Where fishing power increases markedly, adjustments in regulations may be required.

54. Discussions generally concluded that gear restrictions and/or size limits can be important components of a management regime; they can be used with considerable flexibility and sophistication to achieve the economic and biological objectives sought. Under favourable conditions - especially in single-species fisheries where the restrictions are understood and accepted by the fishermen - they have been successful. Even in these circumstances they cannot resolve a number of problems, including the economic problem of over-capacity. In other conditions, they may be of very limited value.

55. The Consultation noted that in Alaska (where penalties for infringement are severe), in a multi-species fishery, fishermen have been successful in keeping the catches of non-target species within the legal limit.

Responses of fisheries

56. Two papers (2.2 and 2.9) were presented describing the dynamics of fisheries and fish stocks. Both of these studies emphasized that fisheries were dynamic systems, and that events in fisheries, even in the absence of active management intervention, were more complex than described by the simple, static models.

57. The first paper noted that all types of unregulated or open-access fisheries can do damage to stocks, and evidence from prehistory and history bears this out even for artisanal examples.

58. Several people commented that, where self-regulation mechanisms applied, they had developed over a long period, sometimes hundreds of years. Often fishing was occurring at such a low rate that the stock was not seriously threatened and, in any case, the rate of change of fishing was slow. It cannot be concluded that we can expect this mechanism to always work, especially with modern technology, where even a conservation-minded person or group could damage "their" stock through ignorance of the effects of harvest or inability to act cooperatively. Also, fishing effort can build up to a seriously damaging level before even mild effects become apparent.

59. Passive regulation occurs when, for one reason or another, fishermen turn from fishing to other activities. It may come into play for religious or cultural reasons. An example would include fishermen staying at home on religious holidays and cultural taboos against eating fish at certain times. It may also emerge when an individual or cohesive group gets property rights to a fishery.

60. Passive regulation may guarantee the safety of the stock, often at the expense of under-utilization. The lack of modern technology in primitive fisheries generally means that usually only a fraction of the stock is exploited and, in many cases, fishing is only one of a range of alternative activities.

61. It was emphasized that even artisanal fisheries using "primitive" gear can over-fish stocks, especially when the transition from subsistence to a market or barter economy is made. The existence of a market for fish, and outlets to a wider group of consumers may in fact be the triggering mechanism to improvements in efficiency, and hence may increase the possibility of over-exploitation.

62. It was also noted that the group controlling access to fishery resources has had to exert tight internal control both on the activities of the members and to some extent on the size of the group. History has shown that these groups and their rights can be quite fragile. For example, one group may control itself, as

well as the distance of other groups from its grounds, and this may lead to property rights ensuring adequate conservation. However, technological innovations (e.g., outboard engines, new types of gear) which give outsiders access to their grounds may destroy this system.

63. Where individuals pursue more than one occupation, passive regulation is enhanced and maintenance of fishermen's incomes is made easier. This is in contrast to the view that full-time fishermen should be given precedence. Indeed it was pointed out that this occupational pluralism may alleviate the difficulties of bringing about a reduction of effort when exploitation is too high. This is not the case when full-time specialized "fishing castes" develop, which are often unable to diversify their activities in this situation. As such, pluralism in harvest activities probably has been an important safety valve in traditional fisheries.

64. There was agreement that, generally speaking, "locals" have had more incentive to self-regulate a particular fishery than have nomadic roving fleets. However, it was stressed that even locals can over-exploit a stock if there is not adequate social control of the number of local participants.

65. The second paper paid more attention to the interacting dynamics of fish stocks and fisheries. It stressed that, although equilibrium theory analysis (yield per recruit analysis, production modelling) may be appropriate as a first step in analysis of a fishery, instabilities in economic and environmental factors may destabilize fisheries in both the short and long term, in ways which cannot be accounted for in terms of equilibrium theory.

66. Management should be planned and implemented taking this likelihood into account. It is often the case however that managers and participants take a short-term view. Thus they may miss some very important aspects of fisheries utilization, and may themselves contribute to later instabilities in the fishery.

67. The existence of instability and periodic fluctuations in fisheries is not readily appreciated within fishery management because of the generally short time horizons of those involved, and the short historical data series generally available.

68. One of the principal causes of cycles and irregularities in fisheries can be variable recruitment, which in turn reflects long or short term variations in biological production in the environment. However, oscillations may occur in otherwise stable systems, and in general are initiated by investment by a few enterprising fishermen, involving perception of new fishing techniques, new markets, and increases in abundance of traditional or new resources. The success of the innovators may lead to rapid increases in participation, and the paper presents the thesis that this process of "effort overshoot", perception of it, and feedback of information allowing its subsequent slow correction by legislation, retirement and diversification of vessels and fishermen, may in itself be the cause of oscillatory behaviour in otherwise relatively stable systems. Discussion revealed several bodies of theory, both biological (e.g., predatory-prey theory) and economic, which could lead to such cyclic behaviour, and it was clear that the interventions by management subsequent to the initial investment phase would be less effective in correcting the effort imbalance than effective control of the rate of entry of new effort early on in the cycle.

69. Considerable discussion centred on the economic aspects and causes of cycles. For one thing, fishermen themselves may show a "life cycle", where they start as crew members, get a small boat, then a bigger boat, etc. Depending on

the size of cohorts of fishermen passing through the system, this factor can lead to cycles in fisheries. Also, fishermen can "switch" from fishery to fishery depending upon the relative profit potential of harvesting different stocks and the ease with which they can re-equip their boats, although here the progressive sub-division of marine areas by EEZs, national closing zones and licence limitation is severely limiting this latter mechanism. In addition, there is a life cycle of boats, which can be affected by fishermen's perception of the stability of stocks; thus, if they perceive that the stock may decline after a few years, they will obtain relatively short lived, and hence less expensive gear. Therefore, they can move when the stock starts to go down. However, if they guess wrong, they may, depending on the versatility of their gear and skills, stay in the fishery causing a deeper decline in stocks.

70. It may be useful to distinguish between naturally fluctuating or even "catastrophe-prone" stocks, and stocks that are normally stable. The paper distinguishes between four categories of fisheries: (1) stable - equilibrium models may be applied in management; (2) regularly fluctuating due to environmental periodicities - fisheries forecasting may then be possible; (3) fisheries may show irregular fluctuations; and (4) periodic growth and collapse of resources or their replacement by others may occur. In the latter two categories, it may be a useful strategy to manage using the low years as a base and then take advantage of joint ventures, foreign mobile fleets, etc. to pick up the excess in good years. In the latter case, appropriate control taking into account the political and equity considerations is necessary.

Regulation of effort by vessel licences/gear control, fishermen licensing

71. A number of papers (3.2 to 3.8) were presented under this topic, bringing to the attention of the participants the experience of countries or regions advanced in the use of such tools for effort regulation: Alaska, Australia, Canada, Israel, Japan, Malaysia, Norway and the USA. The experiences reported were varied. In some cases there had been difficulties in implementing the measures, and they had not been fully successful in achieving the policy objectives. In a number of other cases the measures appeared to have been successful, and were considered as such by the fishermen.

72. The following discussions considered the appropriateness of limited licensing systems in reaching some of the basic goals of fishery management such as: conservation of the resource, economic efficiency, equity and administrative-political feasibility.

Conservation of the resource

73. The most frustrating problem of fishery management is the tendency of fishing effort to increase with time up to a point where the existence of the stock and of a viable fishery is threatened. Simple quota policies have generally not succeeded in reducing effort in over-developed fisheries. This often results in shorter and shorter fishing seasons, upsetting the marketing sector in many cases. As a consequence it would seem that better tools are needed in order to control the level of effort and licensing is one of them.

74. It was felt that excess fishing capacity may weaken the capability of other fishery management measures (like mesh size, area closures or closed seasons) to protect the viability of certain fisheries by reducing vessel profitability to a

point where illegal fishing was the only alternative for survival. Also, excessive capacity creates political pressure to increase TACs or readjust allocations. When capacity is too large in several countries, this can both create additional pressure to enlarge the TAC and hinder international negotiation on allocation of the TAC among nations.

75. A key question was whether, in the absence of a limited entry scheme, a self-regulating (bio-economic) mechanism might exist to stop increases in fishing effort at some level before any serious damage to the biological system; with declining catch rates fishermen would voluntarily leave the fishery. The Consultation pointed out that this will not occur if the fishery remains profitable at very low abundance levels (high priced/low cost species), if abundance declines more rapidly than catch rates (as occurs in most of the small pelagic resources, for instance), or if the fishermen have too few alternative fishing opportunities.

76. The dynamic adjustment processes in fisheries were discussed at length. A strongly held view was that licence limitation should be established when a fishery was growing, whether this was because a stock had previously been lightly fished or because improving environmental conditions were increasing the size of the stock. However, for most developed fisheries, this is a forlorn hope.

77. It was also noted that licence limitation has often been introduced in the past when a stock was on the decline most probably under the combined effect of fishing effort and natural/environmental changes. In these cases, licence limitation is politically easier to propose and introduce, but positive results (restoring stocks) will be very difficult to obtain.

78. The Consultation concluded that licensing was a technique that could have positive effects on the conservation of the resource as far as it could actually maintain the fishing mortality below some predetermined levels. It was generally necessary to combine licensing with other regulations in order to achieve this objective.

79. The Consultation believed that a particularly difficult problem is the management of a multi-species demersal resource. Using limited entry, some species would tend to be over-harvested while other species would be under-harvested. However, this is a problem with any method of managing multi-species harvests and limited entry may be the best way to deal with a difficult issue.

80. It was pointed out that the conditions under which licences were granted provided a valuable and flexible tool for managers. In particular, provision of adequate data (e.g., records of what fish were caught, where, and with how much fishing) could usefully be a condition of holding a licence.

Economic efficiency

81. It was generally agreed that licensing alone was not sufficient to enhance economic "gains" by decreasing the excessive fishing capacity. Average fishing power per vessel tends to increase through introduction of new technology and other investments in each vessel since the incentive for higher investment still exists in the search for larger shares of the potential capture of the group of licensed fishing units. The result is generally an increase of the boats' fishing efficiency, a shortening of the fishing season, and consequent market and employment disruption ashore.

82. In order to improve the efficiency, the regulation scheme should therefore comprise a package of complementary measures aimed at avoiding this tendency toward capital accummulation. In that respect monetary measures (raising licence fees, taxes, etc.) can be useful tools in reducing incentives for over-investment (cf. paragraph on Monetary Measures).

83. The principal parts of the discussion relating to economic well-being involved the question of stabilizing income over a period of time by mitigating the effects of fluctuations caused by variation in fish abundance, prices and cost. In some cases an emergency fund filled in years of above average catch are used to compensate low incomes in meagre years. Representatives from several countries described such income stabilization programmes for fishermen.

84. Licence limitation programmes have often improved fishermen's earnings, but have less often led to large collections of tax revenues. No consensus emerged from the discussion as to the appropriate level of licence fee, some arguing for high fees to recapture management costs and create appropriate emergency development funds and others to low fees, in consideration of the low income level and political vulnerability of certain fishing groups.

85. Despite the shortcomings there was a feeling that some of the obvious benefits of limited entry were preventative; the situation would have been worse if they had not been introduced.

86. It was finally noted that increases in per-vessel capacity may be at least offset by a scrapping programme or a buy-back policy (whose cost could possibly be supported by the fund fueled by licence fees). The buy-back can also be undertaken by the fishermen themselves.

Equity

87. Equity considerations are amongst the most elusive of fishery management. They are based on particular objectives which are generally not found elsewhere. Instead of looking for restrictions on hours of labour, wages, working conditions, they aim at ensuring protection of small-scale fishermen against adverse effects of industrial fishing, of particular minority ethnic groups, etc. The main questions are: When licences are limited who gains? Who loses? Are the changes fair and reasonable?

88. An important question is: Who should be in the scheme? Considering that open access would automatically lead to excess capacity under most conditions, three possible rules of qualification for licences were discussed:

- Selling and auctioning to the highest bidder
- Giving priority to the historical presence in the fishery
- Using regional and national socio-economic criteria

89. Participants with significant experience in countries possessing artisanal fisheries argued strongly that licensing systems should be used carefully, if at all, when they adversely affect national goals for protecting the well-being of artisanal fishermen. Examples were given of special treatment of aboriginal fishermen in the USA and Canada and artisanal fishermen in Japan.

90. It was also suggested that full-time fishermen are frequently singled out for particular treatment. Such special consideration was however dependant on circumstances, and generalizations were not reached.

91. Some speakers suggested that initial qualification rules as well as rules for later entry would be more equitable if they were developed in close collaboration with fishermen, their associated industry and community and others responsible for the fishing communities.

92. In addition to consultation when the programme is designed, Appeal Committees are often constituted to resolve disputes arising from programme implementation. Some participants felt that these committees would be more effective if they were to include fishermen either on the committee or in a close advisory capacity. Other participants reported that direct involvement of fishermen has had very negative effects. In order to avoid too frequent appeals, administrators have often chosen to err on the side of liberality leading sometimes to an undue increase in the number of licences initially distributed.

93. It was pointed out that it was also necessary to decide whether licences were to be transferable and whether they were issued to the vessels or to the fishermen. Licences might be non-transferable, transferable only to fishermen or to fishermen from specific groups or family, or transferable to any purchaser on a free market.

Political and administrative feasibility

94. Concern was expressed that licence limitation would be followed by increasingly complex regulations. Others noted that licence limitation is a tool most often adopted in a fishery which was already in trouble; the number of regulations may simply reflect a problem which cannot be left alone and which may be difficult no matter what approach is taken. It was however agreed that, whenever feasible, it was preferable and easier to start a limited licensing system as soon as possible and possibly before the situation becomes really critical.

95. In countries with much experience in licensing, the limitation system has evolved slowly with time through trial and error. Some countries wishing to adopt licensing schemes today might be expecting optimal solutions to emerge too rapidly.

96. It was noted that a moratorium was generally a measure taken rapidly in case of crisis, and on a temporary basis, to freeze effort levels while preparing a more complete (and longer term) limited licensing programme. Licences were also a useful tool for short-term management (to open or suspend fishing operations at short notice).

97. It was noted that, as usual, fishermen would accept effort restrictions more readily if they were convinced (and could effectively ensure) that other participants to the fishery were being equally treated. The responsibility for this aspect will generally be left with the administration which will have to develop an adequate programme of monitoring and data collection.

98. In developing countries a serious problem was encountered in the lack of effective enforcement and the use of licensing as more of a revenue collection mechanism than as a means for conserving the resources.

Conclusions

99. Limited licensing of fishermen, vessels, gears, etc. was generally considered by all participants as a potential management tool to be carefully considered. Its adoption must be considered in the context of the economic and social system of the relevant country and region.

100. This tool must be complemented by other regulations to limit some unwanted potential effects. Before designing the scheme, the objectives for management should be specified as far as possible and, when using a new policy, a careful programme of monitoring should be undertaken; problems should be anticipated and corrections be made timely to ensure the suitability of the results for the fishery concerned.

101. It was also felt that limited licensing could be a useful complementary tool to TAC/quota policy in order to ensure some required allocation at the national level.

102. At the meeting the only experience presented with respect to licence limitation for artisanal fisheries related to aboriginal populations of North America. While that experience was reported to be relatively successful, some participants felt that licensing systems might not be applicable to coastal fisheries in developing countries, rather they emphasized satisfactory results from using property rights systems in artisanal fisheries while licensing industrial fisheries. Other participants believed that licence control may have value in all fisheries even in developing countries.

Regulation of fishing effort through monetary measures

103. The meeting considered the general features of these controls, as presented in the review paper. Emphasis was given to the positive aspects of financial measures with particular reference that such measures must be severe enough to negatively affect what the fishermen intend to do. Examples cited were the Icelandic system of taxing preferred species and subsidizing under-utilized species as well as the Bardawil lagoon system where taxes paid by fishermen were used to maintain the environment at its productive level.

104. Questions were asked to clarify the tax/subsidy scheme for Iceland and it was explained that this approach was made possible because of fixed prices for species established for the season. In effect, therefore, the price of cod was set below market price and the price for redfish above market price. It was pointed out that this system would be difficult to implement if fishermen had to compete with imports of the same fish, or different fishermen fished the species separately.

105. The paper describing monetary measures was introduced with the emphasis of describing the difference between economic theory and the actual practices found in fisheries. It was stressed that the paramount objective in many fisheries is in practice not the mazimization of economic surplus, rather the economic viability of relatively remote areas.

106. Attention was given in this paper to the impact of subsidies intended to increase employment opportunities and improvements in income levels. Higher incomes and embodiment of technological innovations led to greater over-capacity. When over-capacity was reached, it was not then possible to remove subsidies because the economic condition in the fishery had declined and, in fact, the need for subsidies increased.

107. In addition, it was pointed out that with the extension of 200-mile limits, many governments are less interested in imposing taxes than in subsidizing capital as a means to stimulate investment for further development of fisheries. Such an approach has directly frustrated fishery management.

108. Attention was directed to the effect of subsidies in one country where increases in fishing effort were attributable to subsidies and which resulted in increased levels of harvest. Each stock soon became fully utilized and has now resulted in a lack of competitiveness which would not have occurred without subsidies. Management had then to respond by imposing regulatory measures.

109. The conclusions of the paper were:

(a) Licence fees must be maintained to restrict investment and over-capacity.

(b) Taxes on fishing are in many cases not necessary since it would be sufficient to withdraw subsidies to reduce fishing effort.

(c) Economic support may be necessary to stimulate the industry but this should be directed to infrastructure and not to direct the fish harvesting sector to carry the burdens of a society's problems.

110. In his summary the author indicated how subsidies moved from a positive stimulus to a negative one as full exploitation of the resources was reached and over-capacity commenced.

111. Taxes were reviewed and it was noted that, in most cases, these were not proportional to fishing effort. In particular, in some countries, the mechanism for tax changes is too slow to be effective as a means to alter fishing effort from year to year when stock size varies, e.g., due to the occurrence of good or bad recruitment. But licence fees capable of recouping some of the management costs, plus landing fees based on gross weight at the processing plant, have both monetary and statistical value.

112. There was considerable discussion of the role of financial support programmes. There were some strong feelings that such programmes could lead to major problems, and should only be introduced after careful thought. Many subsidies have so distorted fisheries that it is very difficult to understand the true economic situation. For example, fuel subsidies to fishing vessels could tend to help large fuel-hungry mobile fleets at the expense of local fleets, often in remote areas, but close to the resource.

113. Financial support is introduced for various reasons. Examples of reasons are the stimulation of development of fishing on an under-utilized resource, and resolution of problems in a developed fishery due to over-capacity arising from such temporary crises as market failure and recruitment failure. These reasons are sound and often lead to wise investments by the nation or international bodies.

114. The Consultation felt that there were often good cases, especially in developing countries, for the first type, to stimulate growth. However, even here there are dangers in that, once granted, subsidies are difficult to stop. They can therefore continue after the fishery develops, and lead to problems of over-capacity. Some forms of subsidy (e.g., low interest loans) may be easier to discontinue than others.

115. There was felt to be less justification for the second class of financial support, unless they could be made strictly temporary, e.g., for a few months after a severe storm. However, it was noted that in some multi-national fisheries temporary subsidies had been adopted by individual countries to maintain their fisheries in existence pending the introduction of a national management scheme.

116. A common problem with financial support programmes is that they are often indiscriminate. Subsidized vessels constructed for under-exploited species will often, in the absence of other controls, engage in fishing for over-exploited fisheries. There are often political difficulties in making subsidies selective in favour, for example, of fishermen in remote areas. At the same time, some types of subsidies could be used to correct some of the distortions in the existing economic system, e.g., by providing loans to small-scale fishermen without ready access to normal credit facilities.

117. The Consultation noted the financial pressures that could lead to problems in the fisheries of developing countries. In these countries bilateral assistance agencies, international development banks and other agencies are providing funds to help develop fisheries. In principle, this assistance should be highly welcome, and very often it has been properly applied and has proved successful. However, there have been occasions when the results have been the importation of inappropriate methods of fishing, and the growth of severe over-capacity. This can occur because some of the interests of the agencies may in part be concerned with the over-capacity of fishing vessels or shipyards in the donor country, or with implementing a large-scale loan without considering whether a smaller loan (e.g., for 20 trawlers rather than 400) might be better.

118. The Consultation felt that some of these problems arise because of the inadequate links, within national governments and international agencies, between those concerned with "development" (building more boats), and "management" (e.g., reducing over-capacity).

Regulation of effort through property rights

119. Papers in this session outlined the system used for allocating rights to artisanal fisheries in Japan, individual quota programmes in Atlantic Canada for herring and groundfish and discussion at a recent technical consultation on Territorial Use Rights in Fisheries (TURFs). A brief summary was also given of consideration in Alaska of an individual fisherman's shares approach to allocation of a quota for Pacific halibut. Finally, success was reported with a quota-shares system in the Lake Superior chub fishery in the United States.

120. A general conclusion of these papers, and of earlier discussions during the Consultation was that if fishermen could be given enough degree of property right in the fisheries, when they felt them to be "over-fished", they would be more responsive to management. Indeed, they might propose measures that were more restrictive than those put forward by administrators. There were, however, practical limits (e.g., the degree of mobility of the resource) and political and legal obstacles to the widespread or immediate adoption of this approach.

121. In Canada the property rights approach held considerable promise but, being introduced late in the east coast fishery's history, it faced enormous problems caused by the multitude of fleet types and multi-species fisheries. The concept was one that fishermen took time to get accustomed to and was difficult

to be accepted by fishermen whose groups were divided among themselves by different gear types and vessel sizes, all competing for the same resource. Even companies had problems in taking full advantage of fish property rights for their vessels. However, the conclusion is that the fisheries in this region are over-regulated and that the property rights approach holds promise for deregulating these fisheries.

122. It was noted that property rights might be an unfamiliar concept in fisheries, but that they had been used for centuries in some places (e.g., Japan and Sri Lanka). On land they are, of course, widely accepted as contributing to efficient use of the land.

123. Property rights can take many forms. These include allocation of fish (e.g., a share in the TAC), territory or fishing licences. Rights can be granted to individuals, or to communities. The former is a form of limited entry, but a community owning fish 'property' would probably have to consider additional controls (e.g., on the number of vessels).

124. Some concern was expressed that property rights, as a means of managing fisheries, is unfair and not egalitarian, since it favours those securing such rights whilst denying opportunities to those who cannot secure them. While ownership of rights does have distributional implications, such should not be seen as unusual, since property rights are a fundamental aspect of access to resources in terrestrial enterprise. It was, however, emphasized that those enjoying such benefits should pay for them in the form of royalties (or other arrangements) to cover the costs of research and administration involved.

125. The Consultation noted that territorial use rights in fisheries (TURFs) had worked well for centuries in various locales, especially in coastal and inshore regions. Where conditions (e.g., the lack of mobility of the resource) allow, a TURF can be a good strategy for management if it provides an equitable distribution of benefits, provides conservation, and provides revenues for the government sufficient to pay the costs of management. A TURF may also provide an incentive to participants to make investments in their fisheries, and induce governments to help under-write or finance the same. TURF schemes should be flexible, allowing means to sell or transfer shares, merge with adjacent TURFs, etc. Vigilence is necessary to guard against deterioration of TURFs - situations in which ownership goes into fewer and fewer hands, to monopolize, etc. The essence of a TURF system is community, rather than individual ownership. It was noted that in coastal areas there could be conflict between property rights in fisheries, and the interests of other users of the coastal waters.

EVALUATION OF TECHNIQUES OF REGULATING FISHING EFFORT

General Conclusions and Proposals for Action

126. One of the reasons for calling for a thorough re-examination of the Law of the Sea a decade or more ago was the concern with the depletion of many fish stocks, and with the difficulties in dealing with this under the current international regime. The new Convention provides countries with the opportunities, and also the responsibilities, to manage fisheries, especially within national EEZs. Without management, resources can be threatened, the amount and stability of fish supplies reduced, and countries can fail to achieve the considerable economic and social benefits that can come from healthy fishing industries and fishing communities. At the same time, all management, in the sense of one form or another of government intervention, has some costs, which tend to increase with the amount and complexity of the intervention. There must, therefore, be a favourable balance between the costs and benefits of any proposed management. This balance will vary with the state of development of the country and of the specific fishery. There may even be some cases where conditions (e.g., small size of the fishery, and difficulties of intervention) may mean that a management decision by the Government not to attempt to regulate fishing effort would be justifiable.

127. Participants in the Consultation had been chosen on the basis of their experience in successful and unsuccessful regulation of fishing effort. These experiences had inevitably been predominantly in the developed countries in the North Atlantic and the North Pacific where over-capacity has been a crucial problem for the last twenty years or so. It was recognized that having identified the factors of success and failure in developed countries further studies and consultations were necessary to evaluate the possibility of transfer of these experiences into the terms of specific advice to individual developing countries. There was, however, a considerable range of conditions within countries, and it was believed that these subsequent discussions would be best handled at the regional (e.g., south-east Asia, Latin America) level as already planned, for instance, in the Committee for the Development of Fisheries in the Central-Eastern Atlantic (CECAF) in 1983.

Objectives

128. The Consultation reviewed the general objectives of fishery management and the criteria that might be used in evaluating different systems. It was emphasized that there must be an understanding of the objectives before starting to manage but this need not require explicit and detailed specification of the objectives. Indeed there might be advantages initially in leaving the statement of objectives in general terms. There are a variety of objectives that might be considered. These cannot always be achieved simultaneously and it may be desirable for the decisions between objectives to be taken over time as part of the regular management process.

129. It was agreed that objectives could be placed in three groups - maintaining the resources, economic performance, and equity (or social needs). These could be used as criteria in judging the performance of different management schemes, but in addition the transaction costs (the costs of research, administration and enforcement) should also be taken into account. That is, the cost of achieving the mix of objectives (cost/benefit) is an integral part of the iterative process of setting and refining objectives. It is recognized that quantification of benefits is sometimes difficult. But it is essential to the decisions on amount, methods and complexity of regulation.

130. The Consultation recognized that attaining maximum economic rent is not normally the main objective for fishery management. Even when accepting this, it should however be stressed that objectives concerning economic efficiency should not be omitted. If they are ignored the long-term effect would be that the fishery sector develops into a burden for society rather than the source of secure employment and food supply. The criteria used to determine economic efficiency will obviously vary from country to country owing to employment needs, scarcity of fuel and other special conditions.

131. Some of the conflicts/trade-offs between objectives, e.g., between high employment and high income per man, are well recognized. Less widely discussed is that attempts to have a high annual yield increase the risk of a stock collapse. There is, therefore, a trade-off between risk and size of catch and also of administration and other costs. Costs of necessary research are also likely to be less if some reduction in yield from the theoretical maximum is acceptable, and a conservative level of yield is taken.

132. A commonly stated class of objectives is the attainment of some form of stability, e.g., in fishermen's income or supplies to the producer or consumer. However, all fish stocks fluctuate naturally, some greatly. Management cannot be expected to eliminate these fluctuations and their subsequent effect on catches. A more reasonable objective is to reduce them, but it should be emphasized that this will be particularly difficult if a high level of average yield is also required. Some reduction in the harmful impact of these fluctuations can be obtained by the use of 'insurance' funds which in some countries may become an integrated part of the fisheries management system.

133. Most objectives are concerned with fishermen, and nearly all management measures affect fishermen. They are most unlikely to be successful unless fishermen participate closely at all stages and understand and support the measures proposed.

Choice of management tools

134. The manager has an array of tools available to him - catch quotas, closed areas, gear restrictions, etc. The Consultation felt strongly that in most cases an appropriate mix of these tools would be needed. One tool - e.g., a catch quota - can only achieve a limited amount. The Consultation had the opportunity to explore the use of the various tools through the experience of the various participants. It noted that each type of measure was likely to have broadly similar effects wherever it was applied, although there could be some variation between high and low latitude fisheries. The actual choice must be made to meet the special circumstances of each fishery.

135. Flexibility in management is important. The manager should be able to adjust the regulations quickly in response to new information, e.g. to close an area for a time when the proportion of juvenile fish in that area is particularly high. The legal and administrative framework for management should be such as to allow such flexibility.

136. Historically, indirect methods such as closed areas and mesh controls have often been the first to be applied to a fishery. In some circumstances, especially when they can ensure protection of the fish until they have spawned at least once, they can by themselves achieve adequate protection of the resource. Additional measures may be needed for economic or social reasons, though some indirect measures (e.g., closure of coastal belts, mesh size of trawls) can also be

of assistance. In other circumstances (e.g., single-species trawl fisheries) mesh regulation or closed areas can make major contributions to improved management. Although there are some fisheries where these measures may be of less help, where applicable, they can be generally understood and accepted by the fishermen; therefore, they are valuable and can be enforced relatively easily.

137. Multi-national fisheries present special problems. Indirect methods such as a minimum mesh can be applied to all participants, but application of direct methods requires some decision on allocation between countries. It was believed that this would have to be done in terms of catch, e.g., allocation of national shares in a TAC. However, countries still have a wide choice of methods (catch quotas, effort limitation) to ensure that their catches stay within their national allocation.

138. Partly because of their historical importance in international fisheries, control by catch limits (TACs) have received particular attention. With some exceptions (e.g., short-lived highly variable species), TACs can in principle solve the conservation problem for single species. However, the fishery fleets may still possess capacity far in excess of that needed to harvest the sustainable yield. The resultant political and social pressures can put the conservation objectives at risk. Good statistics are essential for applying TACs - this limits their value in developing countries. Enforcement, and the necessary regular scientific monitoring involved in TACs, can be expensive. They are also of limited value in multi-species fisheries.

139. Economic and social problems may be reduced if national TACs (or shares in the multi-national TACs) are allocated to groups of fishermen within the country, though considerable control problems will remain. This allocation, which may be considered a form of property right, might, for example, follow the practices used in several countries represented at the Consultation - subsistence (fishermen who only fish for their own consumption) artisanal fishermen, fixed gears, semi-mobile gears and mobile gears last.

140. Direct control over the number of fishing vessels through limited entry or licensing appears to offer the best chance of solving the problems of over-capacity. In principle, this approach should also solve the conservation problems. In the long run, however, the true impact on the stock can reach excessive levels through improvements in the size and efficiency of the individual vessels. This effect is also economically undesirable because of the large capital expenses that may be involved. Licence limitation should always include controls on the effective fishing capacity of the individual licensed vessel (e.g., on tonnage or horsepower). Even so, there will usually be some technological improvements. To deal with this, the management authority needs, in the long run, to be able to reduce the number of licensed vessels (or their combined tonnage). For some stocks, e.g., shoaling pelagic species, there can be a more serious short-to-medium-term threat through the ability of the fleet to concentrate on the remaining schools of a dwindling resource.

141. Licence limitation or limited entry may be easier and involve less disruption if they are introduced when a fishery is still growing, rather than when over-capacity and over-exploitation is already a problem. It is difficult to achieve an immediate reduction in the amount of fishing by these measures, and the immediate effect of introducing or threatening to introduce these measures may actually be to increase effort. Introduced early, however, they can put a lid on expansion - though without care this can easily be over shot. There are also practical objections to early measures; for example, governments do not like

spending money to solve problems that will not arise for some years yet. The greatest value of licence limitation, at least in developed fisheries, may be as an adjunct to catch quotas.

142. Money measures - financial support, including subsidies, direct taxes, or tax structures (e.g., depreciation rates) can be useful strategic tools to guide the decisions (by fishermen, fishing companies or investors) in desired ways. They can be misused - financial supports usually are being kept on too long. They are also slow in having an effect, so are no use as tactical weapons; also they can often not be used when management is most needed. Few politicians will increase taxes on an industry that is deep in trouble, even if that trouble comes from over-capacity. Subsidies should be avoided where possible. Where forms of financial support can make useful contributions, e.g., in stimulating the growth of fishing on an under-utilized stock, they should be kept on only for a strictly limited period. Taxes would be most useful in the final phases of successul management to funnel off "excessive" profits, and should mainly be used to cover management costs.

143. In some developing countries there can be financial pressures from bilateral agencies, international development banks and other agencies to increase the size and capacity of their fleets. These pressures, in the form of cheap loans, etc. can be extremely welcome when carefully applied. However, applied indiscriminately they can result in the importation of inappropriate methods of fishing, too many vessels chasing too few fish, damage to the resource, or losses to existing fishermen and to the country.

144. In this connection it was emphasized that the use of advanced technology does not necessarily mean that a vessel is economic. Large factory stern-trawlers rarely catch fish as cheaply as small locally-based fuel-efficient vessels.

145. Property rights can take many forms - individual catch quotas, "TURFs", etc. They have a number of advantages. When fishermen consider the fish stocks as their property, they will adopt a more positive attitute to conservation and management measures. Enforcement is usually easier and cheaper. The product can often be brought ashore in better condition, and over a longer season, to the benefit of the consumer. In general, the Consultation felt that property rights, in one form or another, are among the more promising approaches to fishery management, especially in developing countries densely inhabited by artisanal fishermen.

146. In summary, the main general conclusions of the Consultation were as follows:

(i) Fishery management is essential. Without adequate management fisheries cannot produce the large benefits they are capable of. These include a high and reasonable supply of food, employment in coastal communities (particularly in remote regions) and a high contribution to economic welfare.

(ii) Developed countries have made many mistakes in managing their fisheries. There have been several reasons for these failures, including lack of ability to control the fisheries off their coasts, as a result of the previous international ocean regime. Developing countries, especially those with developing fisheries, may find it more valuable to learn from these mistakes than to attempt to use current practices in developed countries as examples.

(iii) Fishery management can be costly, depending on the desired level of development, especially for research and enforcement. Decisions on management must take into account the balance between costs involved, and the benefits to be expected.

(iv) Fishermen and others (merchants, shore workers, processors, etc.) who are engaged in the industry should be involved in fishery management. They should have the opportunity to participate in all stages from the design and choice of management measures to their implementation and enforcement. Self-enforcement, where feasible, is cheap and efficient, but needs monitoring.

(v) There is no single simple way of regulating fishing. Successful regulation involves using the correct mix of regulatory and other tools available. This mix will differ from fishery to fishery and from country to country. The mix of tools employed must be matched to the specific conditions of each fishery.

(vi) Management cannot be separated from development. Often indiscriminate actions taken to encourage the growth of a fishery (e.g., introduction of subsidies) can have serious impacts on the later success of management. Administration of fishery "development" and "management" functions, whether within a country or an international agency, should be closely integrated.

APPENDIX 1

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APPENDIX 2

PROVISIONAL AGENDA & TIME TABLE

TIME	Monday, 17 January
Morning	
09.30	Opening Address by the Assistant Director-General FAO Fisheries Department
	Introductory Remarks
10.30-12.30	**SESSION I:** CRITERIA FOR REGULATION
	Presentation of papers with 20 min. per paper, followed by 10 min. for questions of clarification, etc.
	Papers:
	Some notes for the Consultation on Fishing Effort (Gulland)
	Objectives and criteria for fisheries regulations (Waugh)
	Fishermen and fisheries management (Thomson)
	Processing and marketing considerations for regulations (McSween)
Afternoon	
	SESSION II: TECHNIQUES OF REGULATING FISHING EFFORT
14.00-17.00	**Panel 1:** Regulation by Catch Limits
	Presentation of papers with 20 min. per paper, followed by 10 min. for questions of clarification, etc.
	Papers:
	ICES Procedures in formulating management advice (Hoydal)
	Biological complexities in the calculation of TACs - Provisional title (Pope)
	Procedures of the European Community in implementing scientific recommendations from ICES - Provisional title (Holden)
	US experiences in allocation of TACs - Provisional title (Gordon)
	Quota allocation by fishing gears for the herring fishery in the Bay of Fundy - Provisional title (Crouter)
	Chilean experience of setting catch limits (Zuleta)
	The problems of quota management in the European Community Context (Derham)
	Enforcement of quota regulations for domestic and foreign fishing - Provisional title (Schowengerdt)

Tuesday, 18 January

Morning

09.00-12.00 **SESSION II : Panel 1** (continued)

i) Setting the total allowable catch (TAC).

This will concentrate on the biological problems of determining the appropriate value of the TAC for the following season.

Afternoon

14.00-17.00 ii) Allocation of shares on a TAC.

This will discuss the desirability of allocation and the principles and processes involved in national and international allocation.

Wednesday, 19 January

Morning

09.00-12.00 **SESSION II : Panel 1** (continued)

iii) Administration of Catch Limits.

This will discuss the steps involved in implementing the catch limits (inspection ashore and at sea), and the indirect impact of catch limits.

Afternoon

14.00-17.00 **Panel 2 :** Alternative approaches to effort regulation and some special problems

Presentation of papers

There will be short discussions after each paper, which should be limited mainly to questions for clarification. Substantive dis-cussions will be dealt with in the following day.

Papers :

Overview paper - Indirect approaches to regulation of fishing mortality (Caddy)

The history and evaluation of closure regulations in the Pacific Halibut Fishery (Skud)

Regulatory measures in the Cuban domestic fishery - Provisional title (Baisre)

Experience in regulating the fisheries of the Bardawil lagoon - Provisional title (Ben-Tuvia)

Discussion on Closed Areas, Coastal Belts and Seasons:
a) By 4 panelists
b) By floor

Thursday, 20 January

Morning

09.00-12.00 **Panel 2** (continued)

Papers :

Fishing gear selectivity and performance (Thomson & Ben-Yami)

Manipulation of fixed gear and the effect of catch-per-unit effort (Skud)

Mesh size regulation and its role in fisheries management (Jones)

Discussion on gear and mesh regulation and their impact on mortality exerted :
a) By 4 panelists
b) By floor

Afternoon

14.00-15.00 **Panel 2** (continued)

Papers :

Self-regulatory mechanisms in unmanaged fisheries - Provisional title - (McGoodwin)

An alternative to equilibrium theory for management of fisheries (Caddy)

Discussion on Overall Impacts of Indirect Management Measures and how they can be applied:
a) By panelists
b) By floor

Discussion of 1st Draft" by Rapporteurs and Technical Secretary

Friday, 21 January

Morning

09.00-12.00 **SESSION II :**
TECHNIQUES OF REGULATING FISHING EFFORT

Panel 3 : Regulation of Effort by Vessel Licences/Gear Control Fishermen Licensing

Introductory Paper :

Practices and problems with licence limitation in the US and Canada (Rettig)

Experience Papers :

Alaska (Tillion)
Australia (Bain)
Japan (Yamamoto)

Discussion

Afternoon

14.00-17.00 **Panel 3** (continued)

Experience Papers :

Norway (Brochman)
Israel (Bar-Ilan)
Malaysia (Majid)
Poland (Ropelewski)

Discussion

Saturday, 22 January

Free

Sunday, 23 January

Free

Monday, 24 January

Morning

09.00-12.00 **Panel 3** (continued)

Discussion on Effects of Direct Control Over the Numbers of Fishing Units

Afternoon

14.00-17.30 **Panel 4 :** Regulation of Effort Through Monetary Measures

Papers :

Iceland (Ellison)
Norway (Brochman)

Discussion

Panel 5 : Regulation of Effort Through Property Rights

Papers :

Canada (Doucet)
Panayoutou

Discussion

Tuesday, 25 January

Morning

09.00-12.00 **SESSION III :**

EVALUATION OF TECHNIQUES OF REGULATING FISHING EFFORT

a) Impact on resources

b) Impact on economic performance including processing-marketing sector

Afternoon

14.00-17.00 **SESSION III** (continued)

c) Equity issues

d) Administrative feasibility/political acceptability

Wednesday, 26 January

Morning

09.00-12.00 General conclusions and proposals for action

Afternoon

14.00 Adoption of formal report of the Consultation to the Secretary-General of the World Conference on Fisheries Management and Development

APPENDIX 3

LIST OF DOCUMENTS

Session	Panel	Title	Author
1	Inf.Paper	Catch, effort and fishing power	J.F. Caddy
1	Paper 1	Some Notes for the Consultation on the Regulation of Fishing Effort	J.A. Gulland
1	Paper 2	Fishermen and fisheries management	D. Thomson
1	Paper 3	Regulation of fishing effort (fishing mortality), New Zealand	G.D. Waugh
1	Paper 4	The interaction between fisheries management and the marketing of fish	I. McSween
2	1.1	Control of the amount of fishing by catch limits	J.A. Gulland
2	1.2	ICES procedures in formulating management advice	K. Hoydal
2	1.3	The problems of quota management in the European Community Context	P. Derham
2	1.4	Notes on the scientific problems of TAC management	J. Pope
2	1.5	Enforcement of foreign fishing quota allocations by the United States Coast Guard	L.N. Schowengerdt
2	1.6	The management of Chilean pelagic fisheries with emphasis on the Spanish sardine	A. Zuleta
2	1.7	Quotas by fishing gear for the herring fishery of the Bay of Fundy	R.A. Crouter
2	1.8	United States fishing effort restrictions and fishing vessel licensing under the 200-Mile limit	W.D. Chappell
2	1.9	Anchovy management by quota	Wm. Gordon (NMFS)
2	1.10	The procedures followed and the problems met by the European Economic Community in implementing the scientific recommendations of the International Council for the Exploration of the Sea on total allowable catches	M.J. Holden

Session	Panel	Title	Author
2	1.11	Management of the Atlantic groundfish fishery under the US Magnuson Fishery Conservation and Management Act, 1977 to 1982	F. Grice P. Colosi (NMFS)
2	1.12	Management of the shrimp fishery of the Gulf of Mexico	NMFS
2	1.13	Management of the Atlantic surf clam fishery under the US Magnuson Act, 1977 to 1982	B. Nicholls (NMFS)
2	2.1	Indirect approaches to regulation of fishing effort	J.F. Caddy
2	2.2	An alternative to equilibrium theory for management of fisheries	J.F. Caddy
2	2.3	Fishing gear selectivity and performance	D. Thomson M. Ben-Yami
2	2.4	Mesh size regulation and its role in fisheries management	R. Jones
2	2.5	The history and evaluation of closure regulations in the Pacific halibut fishery	B.E. Skud
2	2.6	Manipulation of fixed gear and the effect on catch-per-unit effort	B.E. Skud
2	2.7	Regulation of fishing effort in Cuban shelf fisheries: The case studies of shrimp, lane snapper and spiny lobster fisheries	J.A. Baisre
2	2.8	Biological basis for the fishery regulation and management of the Bardawil Lagoon, Mediterranean coast of Sinai	A. Ben-Tuvia
2	2.9	Some examples of self-regulatory mechanisms in unmanaged fisheries	R. McGoodwin
2	3.2	Practices and problems with licence limitation in the US and Canada	B. Rettig
2	3.3	Controlling of fishing efforts: Malaysia's experience and problems	S. Majid
2	3.4	Fisheries management on Lake Kinnereth	M. Bar-Ilan
2	3.5	Fisheries management in Alaska	C.V. Tillion

Session	Panel	Title	Author
2	3.6	Vessel licences, gear control and fishermen licensing in Australia: Australian experience of these and related management measures	R. Bain
2	3.7	Fishery regulations adopted for coastal and offshore fisheries in Japan	T. Yamamoto
2	3.8	Licence limitation regulations: The Japanese system	Y. Asada
2	4.1	On regulating fishing effort through vessel licences	B. Brochmann
2	4.2	Financial measures to regulate effort	B. Brochmann
2	5.1	FAO Workshop on Territorial Use Rights in Fisheries - preliminary report	T. Panayotou
2	5.2	Fishermen's quotas - one method of controlling fishing effort	F. Doucet
2	5.3	The individual vessel allocation scheme for the Bay of Fundy herring purse seine fleet	F. Doucet
		Techniques of regulating fishing effort: the common fisheries policy of the EEC - fisheries management or political compromise?	J. Goodlad

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ISBN 92-5-101394-2